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Black swans, dragons and the phoenix: rebuilding citrus after HLB

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Black swans, dragons and the phoenix are cultural symbols and mythological figures, used here to bring a different perspective regarding the impact of HLB and to establish the transformative nature of the HLB epidemic. Citrus production will no longer be the same as a result of HLB, traditional practices and institutions will change or disappear. This type of event has been termed a “black swan” (Talib 2007) – transformative events that permanently change systems and that are rationalized in hindsight. HLB would seem to be a black swan for citrus production globally. Such black swan events create opportunities for those able to take advantage of them, much like a dragon is an omen of power and good luck in many traditions, though other traditions see dragons as malevolent creatures. Depending your perspective, HLB fits both. Finally, the phoenix is a mythical bird with each new generation reborn from the ashes of the previous and can serve as an icon for rebuilding the citrus industry after HLB. Humans have used myths and symbols to motivate and inspire for thousands of years and even scientists need inspiration and motivation, because as Stephen J. Gould reminds us, “the day-to-day work of science is intensely boring” (Horgan 2015, p. 123).

Preliminary results from an economic analysis led by Dr. Fengxia Dong, an agricultural economist at the University of Wisconsin, helps quantify the economic impact of HLB on Florida citrus. Based on USDA NASS (2016) data, citrus bearing acres in Florida have been declining since 1997, but total citrus production was holding steady until after 2004 when HLB first appeared (Figure 1). The analysis examines how HLB and other factors have affected both new citrus plantings and removal, as well as citrus yield per bearing acre. Figures 2 and 3 graphically summarize the data used for the analysis. Annual plantings of new citrus acres dropped dramatically in the early 1990s and have remained below 15,000 acres since 2004, while removal of citrus acres rose steadily in the mid-1990s to peak in 2006 and since then have remained well-below 30,000 annually (Figure 2). As a result, total citrus bearing acres have been in decline for several years, even before the arrival of HLB. Yield per bearing acre showed no trend from 1990 until 2004, and then dropped dramatically in 2005 when HLB appeared; some recovery occurred after 2005, but a notable decline over the last four years has occurred so

that average yields have fallen below even 2005 levels (Figure 3).

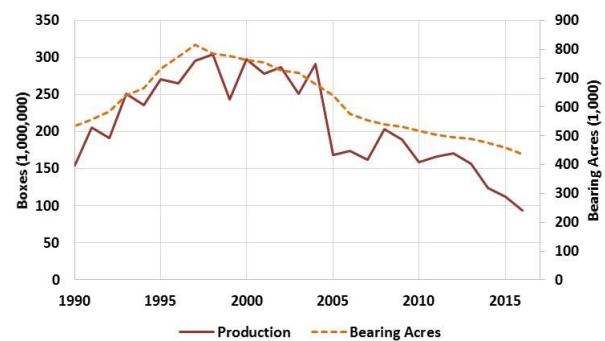


Fig. 1. Florida citrus bearing acres and total citrus production 1990-2016 (Source: USDA-NASS 2016).

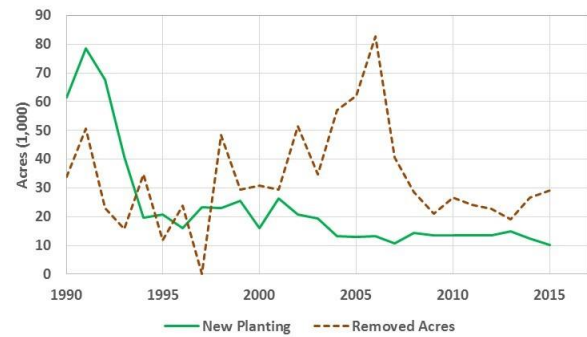


Fig. 2. New citrus planting and citrus acres removed in Florida 1990-2015 (Source: USDA-NASS 2016).

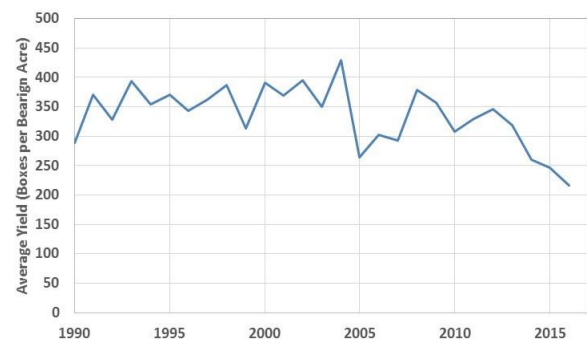


Fig. 3. Average citrus yield (boxes per bearing acre) in Florida 1990-2016 (Source: USDA-NASS 2016).

The summary of the preliminary results here focuses on factors with statistically significant effects on these variables. New citrus planting increases as the expected long-run profit of citrus increases (consistent with economic logic) and as the total bearing acres increases (with more bearing acres, more trees in total require replacement annually). As expected, the arrival of HLB also decreases new citrus planting. Removal of citrus trees decreases when expected short run profit increases (growers delay tree removal if the expected profitably looks high for the next season) and increases as the price of houses increase (conversion to houses become a more economically attractive option). Surprisingly, the arrival of HLB does not have a significant effect on tree removal, implying that HLB's effect operates indirectly through its yield and price impacts on profitability. Citrus yields per bearing acre increase with expected short run profit (growers apply more yield enhancing inputs when profitability look promising) and decline with the arrival of HLB. The results of the yield analysis are used to parametrize a market model in order to estimate the aggregate economic losses to society due to HLB in Florida. Yield declines by more than 29% and grower costs increase by more than 27% (Singerman and Useche 2016; Muraro 2012), which together shift the citrus supply curve backward. Preliminary results show that the reductions in social surplus for this new market equilibrium imply economic losses \$466 million annually to society, with growers bearing almost three-fourths of these losses as lost income.

Looking forward at the rebuilding the citrus industry, research and innovation will play key roles. Different actors with different funding sources and incentives will contribute, not just scientists in labs, but also large and small businesses, farmers and consultants. Traditional research and innovation for insect vector management and tree management will continue to play a significant role in the short term and likely in the longer term as well. More radical solutions based on biotechnology, RNAi and gene-editing technologies have promise, but are almost certainly years away before they are commercially available at scale. Experience with existing crop biotechnologies such as Bt crops and Innate® potatoes suggests that consumer acceptance and resistance management will be major issues for these types of solutions.

The presentation was recorded in a studio after the conference and is available online (<https://youtu.be/Hldqw2vYo48>), as is the original PowerPoint file (<http://www.aae.wisc.edu/pdmitchell/CitrusHLB.pdf>).

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